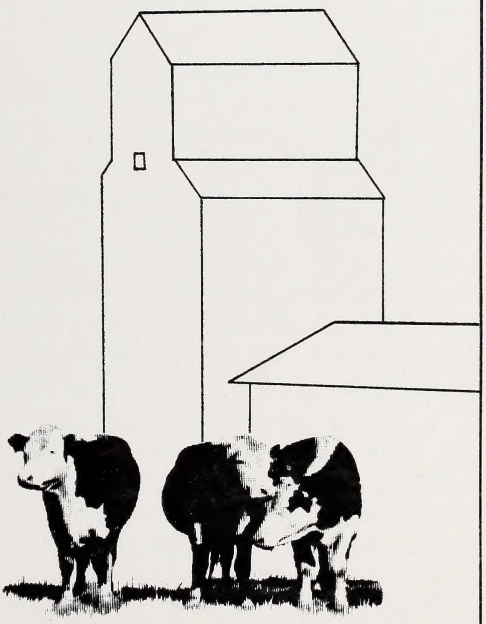
Agricultural Considerations

For Today and Tomorrow



A discussion paper prepared for the Alberta Conservation Strategy Project

Agricultural Considerations
for
Today and Tomorrow

Prepared by
Rural Environment Sub-Committee
of the Public Advisory Committees
to the Environment Council of Alberta

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FOREWORD

In late 1985, the Public Advisory Committees to the Environment Council of Alberta began working toward a draft conservation strategy for Alberta. The Public Advisory Committees (PACs), comprising representatives of some 120 non-government organizations, are in many ways an ideal organization for developing a strategy that should touch the lives of all Albertans. The PACs bring together many diverse viewpoints, we are non-partisan, and we have members from across the province. Since the early days of the project, we have welcomed non-PAC participants, and have been delighted to receive the contributions of civil servants, industry spokespeople, academics, and the general public.

We have made progress since 1985: the *Prospectus for an Alberta Conservation Strategy* has been published and many meetings and workshops have been held. The principle of a conservation strategy increasingly has been endorsed by Albertans, and Alberta has been recognized across Canada as a leader in conservation strategy development. There have been important related events. For example, in September of 1987, every environment minister in Canada endorsed the final report of the National Task Force on Environment and Economy, which recommended that conservation strategies be in place in every province and territory by 1992. This same report was endorsed by the First Ministers at their November, 1987 meeting.

We will have a conservation strategy for Alberta, we hope by 1990, the Canadian Year of the Environment. Our work continues in the expectation that all those who are interested will have a chance to contribute to the project, through public hearings or some other public participation process.

Since the publication of the *Prospectus*, the PACs have concentrated on preparing sectoral discussion papers. The Conservation Strategy Steering Committee determined early on to produce background papers on relevant sectors, such as agriculture, fish and wildlife, tourism, oil and gas, and others. These discussion papers look at the issues within each sector, but, more importantly, they investigate the interaction of each sector with the others. Their preparation has involved consulting with a wide range of interest groups — a conservation strategy principle in action — which has proven fruitful in developing ideas about the ultimate conservation strategy. These discussion papers will be used as background information for drafting a conservation strategy document and, perhaps, in the future, in public hearings on the draft conservation strategy. This report is one in the series of discussion papers.

Because there are as many opinions on our best future direction as there are Albertans, we welcome comments. The conservation strategy will be only as good as the work that goes into preparing it. Please address any comments on this discussion paper or others in the series to the Environment Council of Alberta at the address given on the page opposite. I would also encourage you to make your opinions known at public hearings or other events as they are held. Let's treat Alberta as if we plan to stay!

Joan Snyder
Chairperson
Conservation Strategy Steering Committee
Public Advisory Committees to the Environment Council of Alberta

ABOUT THIS DISCUSSION PAPER

The dominant theme in the discussion papers prepared for the Alberta Conservation Strategy is that good decisions require a good understanding of other points of view. Hence, these papers endeavor to examine relationships both within and among sectors of society. This paper provides an overview of the context within which the farmers and ranchers of Alberta make decisions. The relationships between those decisions and Alberta's renewable, non-renewable, and human resources are also discussed.

Prescriptive answers to the problems facing agriculture in Alberta are not provided in this discussion paper. The intent of the paper is to provide a common ground for discussion among those interested in the future of agriculture in Alberta. Solutions to the issues raised in this paper remain to be sought in other forums.

ACKNOWLEDGEMENTS

This discussion paper was a project of the Rural Environment Sub-Committee of the Public Advisory Committees to the Environment Council of Alberta. Many members of that Sub-Committee participated in the writing and the Sub-Committee dedicated substantial portions of its yearly agenda to review and criticism of draft versions. The members of the Sub-Committee are listed in Appendix A. The discussion paper also benefitted from contributions made by individuals who are not part of the Rural Environment Sub-Committee, particularly Dr. Lawrence Segal of Environment Canada, Judy Ballantyne, Sharon Rempel of the Sustainable Agriculture Association, Elmer Kure, and Gillian Ford of the Devonian Botanic Garden.

Finally, I would like to thank the staff of the Environment Council who helped convert this paper from an idea into a reality, in particular, Dave Buchwald, Director of Research, and Susan Morrow, Editor.

Susan Nelson Pier
Agriculture Sector Leader
Alberta Conservation Strategy
June 1988

Contents

Chapter One

Introduction

This discussion paper is intended to provide a description of the broad context within which the farmers and ranchers of Alberta make decisions. It is written for those who may have limited familiarity with the agriculture industry and the relationships between that industry and other sectors of the provincial economy. The overall objective is to encourage discussion about the contributions farming can make to an Alberta Conservation Strategy, both within the agriculture sector and in its relations with other sectors.

The agriculture industry in Alberta produces a range of commodities: livestock (including poultry), cereal grains and oilseeds, speciality crops, and tame hay. The producer of these commodities is the Alberta farmer, who makes the decisions about how and when to convert renewable and non-renewable resources into commodities that will produce an income and, the farmer hopes, a profit.

Agriculture is a business that, in 1986, employed about 7.6 percent (87,000 out of 1,146,000) of Alberta's employed labor force (Alberta Treasury 1987a). Economic multiplier tables indicate that, for every job created in the agriculture sector, another 0.54 jobs are created elsewhere in the economy (Alberta Treasury 1987b).

In 1986, total Alberta farm capital (57,777 farms) was $28,623,414,155. About 73 percent of this value was represented by land and buildings. The average capital value per farm was about $495,000 (Statistics Canada 1987). In 1985, the agriculture industry represented about 3.4 percent of Alberta's gross domestic product, at factor cost, and yielded cash receipts of $3,800,000,000. In that year the distribution of receipts from major commodities was as shown in Table 1.

Like any business person, a farmer must make a profit in order to survive and continue in the business. Successful business people are able decision makers, and the decisions they make are complex. Complexity in farming arises from five main areas and their interrelationships:

1) Commodity pricing factors
2) Availability of resources
3) Socio-economic considerations
4) Government policies and programs
5) Weather patterns

If a farm is to be successful, some balance must be achieved between sources of revenue and the costs of achieving those revenues. Farming can be considered a way of life, but it is first and foremost a business. Government policies and programs, to be successful, must be responsive to factors influencing farming, while farmers must strive to keep abreast of global factors to make effective business decisions both today and tomorrow.

One way farmers affect all Canadians is by being one of the major users of renewable and non-renewable resources. Farming and farmers, as the manipulators and applicators of major resources, are a vital part of the economy and environment of our country.

Renewable resources, particularly the soil resource, can be used in a manner that is sustainable in the long term. However, these resources can deteriorate rapidly if they are treated carelessly or if short-term perspectives prevail.

Non-renewable resources are non-sustainable; that is, their use cannot be sustained indefinitely, because eventually they will be depleted. Fossil fuels like coal, oil, and natural gas are examples. The definition of "non-renewable" may also require a time or economic context. For example, a timber resource can be considered to be non-renewable if it is being utilized at a greater rate than it is being replenished. Similarly, in the context of farming, soil can be either a renewable or non-renewable resource. If the rate of utilization of nutrients, organic matter, or topsoil exceeds the rate of replenishment, then soil is being used in a non-sustainable manner. For the future of the farm, the provincial farming community, and all Albertans, the options selected should enable the soil resource to be used in perpetuity.

In the context of the Alberta Conservation Strategy, the goal of farmers, as primary agricultural decision makers, should be to ensure the long-term sustainability of the resources upon which they and society depend and to develop mutually beneficial relationships with other users of resources so as to not hamper sustainability.

Table 1. Receipts From Commodities, 1985

Commodity	Dollars (millions)	% of Total Receipts
Total Receipts*	**3,847.5**	**100.0**
Receipts from Crops	**1,949.7**	**50.7**
dominated by:		
wheat	563.2	14.6
canola	340.6	8.9
barley	200.6	5.2
Receipts from Livestock and Products	**1,799.2**	**46.8**
dominated by:		
cattle and calves	1,170.0	30.4
hogs	245.9	6.4
dairy products	215.7	5.6

Source: Alberta Treasury 1987a

* 97.5 percent of total receipts were from crops and livestock.

Chapter Two

Selected Factors Affecting Farm Decision Making

Commodity Pricing

Much of Alberta's farm production goes to the export market: either out of province or out of country. Over the years, the value of exports from Alberta has varied considerably. For example, 1986 out-of-province shipments totalled $2,931,000,000, a 21.6 percent decrease from the previous year. In that year, receipts for out-of-province shipments were about 40 percent for grains and oilseeds, 33 percent for meat and animal products, and 9 percent for live animals (Alberta Agriculture 1987a).

Out-of-country shipments also declined, from $1,753,000,000 in 1985 to $1,663,000,000 in 1986, a 5 percent drop. In 1986, 72 percent of these shipments went to seven countries: the U.S. (22.4 percent), Japan (21.6 percent), the U.S.S.R. (14.3 percent), the People's Republic of China (5.8 percent), Cuba (2.9 percent), India (2.7 percent), and East Germany (2.5 percent) (Alberta Agriculture 1987a).

Wheat is Alberta's major out-of-country export. In 1986, wheat exports were valued at $589,000,000, or about 35 percent of export revenues. This amount was a dramatic drop from the 1985 figures of $822,000,000 and 47 percent of export earnings.

Other significant export products in 1986 were canola and canola products ($268,000,000), barley ($248,000,000), meat and meat products ($175,000,000), live animals ($115,000,000), canola oil ($72,000,000), and honey ($5,000,000) (Alberta Agriculture 1987a).

In recent years, many of our important export commodities, such as wheat, have been dropping in value due to continuing world-wide surpluses. These surpluses have come about for two major reasons:

1) increasing subsidization of agricultural operations, and subsequent increased production in many nations, including the European Economic Community and the U.S.

2) the success of the "Green Revolution" in the developing world (Alberta Agriculture 1987a). For example, China's purchase of grains is expected to be sporadic in the future because the country is approaching self-sufficiency. Imports will likely relate to domestic growing conditions and Chinese government policy.

The quantity and mix of commodities demanded by the markets are critical components of the farmer's decision about what to produce in any given year. Changing the commodity produced may be difficult because of the new skills required, the possible need to change technologies and the costs associated with those changes, the resources available to produce different commodities, and the relationship between farm and other sources of income. These decisions affect the sustainability of the farm and of the resources upon which it depends.

Government policies and programs also influence commodity prices. For example, in Canada, the Canadian Wheat Board markets most grain on behalf of farmers. To do so, the Board sets delivery quotas and the federal govern-

ment sets a base price for the commodity. These prices are determined through an assessment of probable demands and prices. If the market is better than the Board's assessment, the farmer receives additional payments. However, if the market is poorer, the base price is guaranteed. Hence, from the farmer's perspective, demand is set by government action that may or may not match the immediate reality of the marketplace. The risk to the farmer of market variability in the grain sector is decreased through the action of the Wheat Board, and thus specialization in grain production is encouraged.

The reduction in risk associated with the production of grain has significant implications. Prairie farmers have traditionally reduced risk by operating a mixed farm (grain, oilseeds, forage, and livestock). The assumption is that the cyclical nature of grain and livestock markets will be compensatory and, hence, a reasonably stable income is possible. A mixed farm also provides the opportunity to market home-grown grain through livestock when grain markets are tight and livestock markets are stable or buoyant.

Specialization in grain production on a large scale leads to reduced per-unit **input**[1] costs, permitting farmers to make profits with lower risk. However, other countries have adopted similar approaches, which together ultimately lead to global surpluses, reduced prices, and many countries trying to back away from the "garden path" of subsidization.

In the post-surplus era of the near future, perhaps there will be a swing back to mixed farming. This version will not be the classic mixed farming concept of much labor and little technology, but a mixed farming that includes all possible technology and specialization in two or more compatible production areas.

A significant force in the international marketplace is the European Economic Community (EEC). The EEC has virtually eliminated the EEC farmer's risk associated with market variability for the growing of grains. There are guaranteed prices far exceeding those for comparable crops in Canada, along with few restrictions on delivery amounts or acreage seeded. Consequently, from 1970 to 1984 wheat production has more than doubled, and yields in the United Kingdom have roughly tripled in recent years (Schmitz 1987).

Increased EEC wheat production has resulted in increased penetration into world markets. In the mid 1980s, the EEC held about 14 percent of world markets, as contrasted with about 9 percent in the 1960s. Canada has been able to retain about 20 percent of the market over this time, as dips in the sixties and seventies were compensated for by recoveries in the eighties. The composition of Canada's markets also has been changing. There has been a decrease in exports to the developed nations (perhaps due to milling technology, which no longer requires hard red spring wheats) and an increase in exports to Eastern Europe and middle-income countries (those with a GNP greater than $410 U.S. per capita) (Veeman and Veeman 1987). In addition, many of these countries have increased their own production.

Natural Resources

Land

Although a successful agricultural industry requires many resources, land is the most critical.

Land used by the agricultural industry is held in both private and public ownership. In 1986, the total area of farms was 51,040,463 acres, or about 31 percent of the province. About 58 percent of this farmland (29,785,690 acres) was owned by the farm operator and the remainder was rented (21,254,773 acres). About 10,000,000 acres (48 percent) of this land was

1 **Input** — inputs are the elements needed to produce commodities, such as land, financing, buildings, machinery, pesticides, fertilizers, and labor.

rented or leased from government (Statistics Canada 1987), dominated by about 57,000,000 acres in grazing leases and permits (Alberta Energy and Natural Resources 1986).

Alberta's agricultural land is diverse. A frequently used classification system is the Canada Land Inventory (CLI). About 75 percent of the province (about 120,000,000 acres) has been classified for its agricultural potential (see Figure 1). The classification is based primarily upon the range of crops that can be grown, rather than upon potential **productivity.**[1] The production from a class of land depends upon where in the province it is found. There is a consistent pattern that lands in northern Alberta will produce less than lands in the same class in southern Alberta. CLI classes 1, 2, and 3 are often called "prime" agricultural lands and make up about 17 percent of the province. Class 4 lands are found over about 15 percent of Alberta, and classes 5 and 6 (severe limitations for crops) constitute about 23 percent (see Table 2).

In recent years a new soil capability classification system has been developed by working groups affiliated with the Alberta Soils Advisory Committee and the Alberta Agrometeorology Advisory Committee. This new system emphasizes land and environmental factors related to **arable**[2] agriculture (Alberta Soils Advisory Committee 1987), and is intended to replace earlier methodologies, including the CLI, although it is based in part on CLI concepts.

The U.S. Department of Agriculture National Agricultural Land Evaluation and Site Assessment (LESA) is another system that has been developed. LESA determines appropriate land usage through a multidimensional approach involving such facets as use of land for both agricultural and residential purposes.

The capability of lands can change through management practices, including irrigation. Irrigation activity is centered in southern and southeastern Alberta where CLI ratings are low, mainly due to low precipitation. That limitation is removed on the more than 1,000,000 acres presently available for irrigation (Table 2).

Class 1 lands are found primarily in the Edmonton-Calgary corridor and in the Edmonton and Red Deer areas. Class 2 and 3 lands are found in parts of the Peace River region and in a crescent extending from the Lloydminster area through Edmonton, and south to Fort McLeod and Lethbridge. The poorer agricultural soils are in the forested area of the province, along the Eastern Slopes of the Rocky Mountains, in northern Alberta, and in the southeast quadrant.

Water

Alberta has an extensive irrigation system, which is concentrated in the South Saskatchewan River basin. In 1985, Alberta's 13 irrigation districts had 1,143,349 acres assessed for irrigation and 973,913 acres (85 percent) were actually irrigated. In addition, there is a small amount of private irrigation that is not part of the irrigation district system (Alberta Agriculture 1986).

The primary sources of water for irrigation are the Bow, Oldman, Waterton, and St. Mary rivers. Water is usually captured behind on-stream dams and then distributed through canals to the irrigation districts. This part of the irrigation system and the larger canals within the irrigation districts are headworks, which are 100 percent provincially funded. Distribution of water from the headworks is the responsibility of the irrigation district, although 86 percent of the capital costs for rehabilitation of the irrigation districts' internal distribution systems is contributed by the province.

Historically, much of the production from irrigated land has been marketed through beef cattle. From 1982 to 1985, production was

1 **Productivity** — With regard to soil, the present capability of a specific kind of soil to produce a specified plant or sequence of plants. It is measured as outputs or harvests in relation to inputs of production factors, under a defined set of management practices.

2 **Arable** — refers to the capability to be cultivated and to be productive.

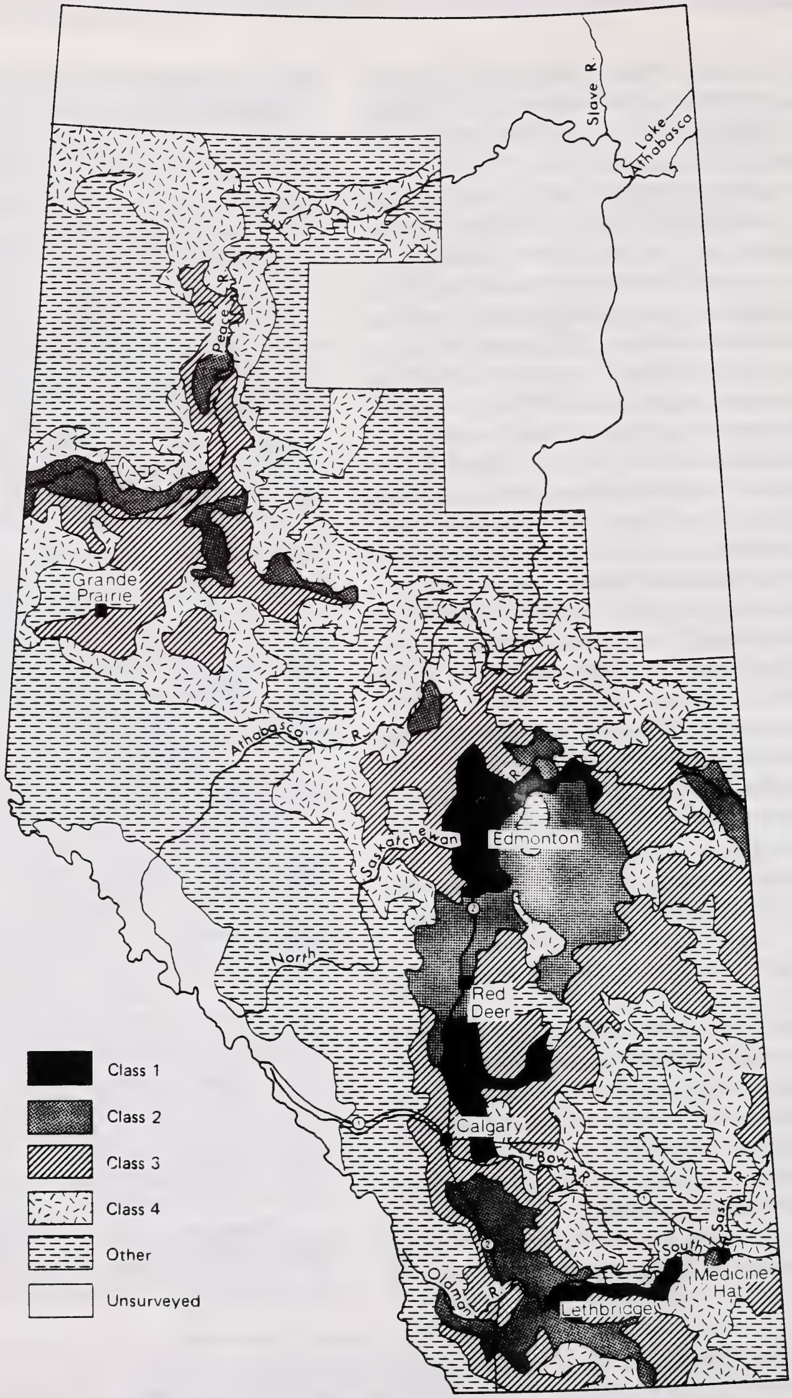

Figure 1. Canada Land Inventory Classes for Agriculture in Alberta

Source: Canada Land Inventory 1976

Table 2. Land Capability for Agriculture in Alberta, Canada Land Inventory

Class	Description	Irrigated Land		Non-Irrigated Land		Total		
		Acres (thousands)	% of CLI Classified Land	Acres (thousands)	% of CLI Classified Land	Acres (thousands)	% of CLI Classified Land	% of Province
1	No significant limitations in use for crops	259.4	0.21	1,748.8	1.44	2,008.2	1.65	1.23
2	Moderate limitations that restrict the range of crops or require moderate conservation practices	356.9	0.29	9,622.6	7.91	9,979.5	8.20	6.11
3	Moderately severe limitations that restrict the range of crops or require special conservation practices	391.4	0.32	15,526.7	12.76	15,918.1	13.08	9.74
Sub-total Classes 1 to 3		1,007.7	0.82	26,898.1	22.11	27,905.8	22.93	17.08
4	Severe limitations that restrict the range of crops or require special conservation practices or both	-*	-	24,544.3	20.18	24,544.3	20.18	15.02
Sub-total Classes 1 to 4		-	-	51,442.4	42.29	52,450.1	43.11	32.10
5	Very severe limitations that restrict capability to produce perennial forage crops; improvement practices are feasible	-	-	28,229.1	23.20	28,229.1	23.20	17.28
6	Capable only of producing perennial forage crops; improvement practices are not feasible	-	-	9,379.6	7.71	9,379.6	7.71	5.74
7	No capability for arable culture or permanent pasture	-	-	11,777.4	9.68	11,777.4	9.68	7.21
Sub-total Classes 1 to 7		1,007.7	0.82	100,828.5	82.88	101,836.2	83.70	62.33
Organic Soils		-	-	-	-	12,772.1	10.50	7.82
Water Surfaces		-	-	-	-	1,797.8	1.48	1.10
Parks and Urban Areas		-	-	-	-	5,258.1	4.32	3.22
Total Acreage Classified by CLI**		-	-	-	-	121,664.2	100.00	74.47
Total Area of Alberta		-	-	-	-	163,382.4	-	100.00

Source: Adapted from CLI (1972, 1976) and Ward (1975).

* Symbol means not applicable

** Only 74.47 percent of Alberta has been classified for agriculture by the CLI.

dominated by grains (wheat, oats, barley, mixed grains, and rye, much of which was used for cattle feed) planted on about 56 percent of the irrigated acreage. The next largest category was hay on about 19 percent of irrigated land. During this same time, on average, about 9 percent was in tame pasture or fodder (green feed, silage corn, **silage**,[1] and grass hay) (Alberta Agriculture 1986). This mix is consistent with past estimates that about 60 percent of the irrigation farmer's agricultural income is derived from livestock (Webb 1982). In 1981, about 39 percent of Alberta's cattle and calves on farms (4,153,000) was in census districts 1, 2, 3, 5, and 6, which include most of the South Saskatchewan basin and 35 percent of the total farm area. By 1985, these districts had about 37 percent of Alberta's cattle population of 3,510,000 animals (Alberta Agriculture 1983, 1986; Statistics Canada 1982).

In recent years, about 10 percent of irrigated cropland has been used for specialty crops (such as sugar beets, potatoes, beans, and vegetables), and around 5 percent has been used for oilseeds (Alberta Agriculture 1986).

Socio-Economic Considerations

Because of the complexity of agribusiness today, agricultural families are under constant pressure to learn, experiment, and take risks with new and costly production and marketing methods. The sociological ramifications of this pressure may have direct effects on the sustainability of agriculture.

Some examples of farm-related stress that may affect agriculture today are:

- financial burdens, such as high debt load, cash flow uncertainty, fluctuating process and markets, and inflationary operating and family living costs
- government policies and control
- multigenerational family farm conflict
- the necessity of off-farm employment
- long work hours and the problem of living in the work environment
- the difficulty of making decisions when changes in management are required.

For example, the wind erosion of cropland soil that results from repeated **tilling**[2] (commonly referred to as "black is beautiful") has not stimulated all farmers to adopt conservation management techniques. Some farmers tend to be great innovators in their soil management practices, while others tend to use the same methodology as their past generation, even though soil requirements, cropping costs, and market potentials may dictate changes in management techniques. Reluctance to change may be due partly to peer pressure, which often influences decisions the agricultural family makes. Ideally, such decisions would be based on logic or factual data. However, pride or peer pressure in some cases may result in illogical decisions that can have deleterious effects on soil conservation.

With regard to economic considerations, off-farm income is a significant contribution to subsidization of farming operations. The need for off-farm income relates to farm debt, to economies of size on small farms, and the financial necessity for certain agricultural management techniques to be subsidized. Menzie and Kraft (1988) point out that, in 1981, the smallest one-third of Canadian farms produced less than 2.5 percent of gross sales. Clearly, many of these are hobby farms with income arising from a variety of sources. However, others may be intensive agricultural operations such as poultry production, market gardens, or production of specialty items.

Farm debt can be a significant cause of stress to farm operators and their families. The seeds of some of the current financial distress were probably planted in the inflationary seventies when it appeared foolish not to borrow. In Al-

1 **Silage** — Fodder that has been stored and allowed to ferment in a silo.

2 **Tilling** — operating implements through the soil to prepare seed beds and root beds.

berta some of the difficulties may have originated with policies of lending institutions, such as the Alberta Agricultural Development Corporation (AADC) and the Farm Credit Corporation, which appraised farmland at market rather than productive value (Lore 1987). In the eighties, the bubble burst — cash flow and profitability became crucial, low foreign demand accompanied a worldwide recession, interest rates rose, and land values plunged. By March 31, 1987, 12.1 percent of AADC's direct loans were in arrears, excluding accounts in arrears for less than one year (AADC 1987).

A productive way to reduce that stress and to help resolve the problem is to accept off-farm employment (Keating et al. 1986; Keating and Doherty 1985) and off-farm income has become a significant part of the total income of farm operators.

In some cases, men take off-farm jobs while women continue to be the farmers. In 1981, about 40 percent of Alberta farmers reported off-farm income and had worked an average of 168 days, or about five and a half months, off the farm. By 1985, those reporting off-farm income had increased to around 44 percent, but the average number of days worked remained about the same (167 days) (Statistics Canada 1982, 1987).

It is important to note that the Statistics Canada Agriculture Census defines a farm operator as the person who is responsible for the day-to-day decisions made in the operation of the farm holding. Only one person is identified for each census farm. This policy leads to a underestimation of the importance of off-farm income to the farm unit, because off-farm income earned by a spouse or other family member is not reported in the Agriculture Census. Certainly, many spouses, sons, and daughters of farmers have brought income to the farm unit through employment as diverse as teaching, nursing, consulting, and a variety of occupations in the oil patch and forest industries. The contribution made to farm income and well-being by the spouse at home, and the help of farm children, have usually been taken for granted and gone unheralded. These contributions are actually a major portion of farm labor and expertise, without which many farms could not persist. In Europe, estimates suggest that on average 87 percent of all farm family income comes from off the farm (Western Barley Growers Association 1987).

In Alberta, the magnitude of off-farm income from other than the census farmer is difficult to determine. A "best guess" by Alberta Agriculture is \$300,000,000 to \$500,000,000 per year or from \$5,192 to \$8,654 for each census farm. If this income is concentrated in the 67 percent of farms that have some level of debt, the corresponding figures are \$7,750 to \$12,916.

These figures seem reasonable. A recent study (Keating and Doherty 1985, as cited by Ballantyne 1987) surveyed Alberta grain farmers about work patterns. It reports that 50 percent of all female respondents had off-farm employment and that, of the 15 percent consisting of couples, she was the only one with off-farm income.

The 1986 Agriculture Census indicates that total gross sales averaged about \$77,433 per farm and that farm business expenses were about \$68,444 per farm. Therefore, average net income per farm was approximately \$8,989. It is clear that the combined off-farm income of the census farmer and family members may reach or exceed income from farming itself.

Government Policies And Programs

Government policies and programs that affect the agriculture industry and its relationships with other sectors of the economy are of two basic types:

1) programs designed to assist directly or indirectly some component of the agricultural industry

2) programs only indirectly connected with the agricultural industry, but which nevertheless have considerable impact on agriculture.

In many parts of the world, including Canada, the agricultural industry and governments have searched for ways to stabilize agricultural commodity prices and farm costs and, consequently, farm incomes. This is usually at-

tempted through mechanisms that guarantee a price for a commodity, or through systems that subsidize input costs. These types of programs help reduce the risks associated with the production of agricultural commodities. The overall objective of Canadian agricultural policy seems to be a desire for stability in the food industry (Fulton 1987).

The commodities produced by the agricultural industry were described on pages 2 and 3. In Alberta the dominant products are cereal and feed grains, livestock products, and oilseeds. Because there are major world markets for these products and because they are important sources of farm income with a large number of constituents dependent on them, they attract government activity — both here and internationally.

A characteristic of Canadian agricultural policy is that many of the programs have originated with crises situations. Regardless of these interventions, and despite the efforts of many individual countries, instability in the world agriculture markets is not decreasing. In Canada, agricultural programs are financed through direct funding by the taxpayer, or indirectly through consumers, as is the case with supply management boards (Fulton 1987). Some are also supported to a greater or lesser extent by funds from producers.

The programs aspect of intervention in the marketplace is complex. The 1985 *Report and Recommendations* on the maintenance and expansion of the agricultural land base in Alberta identified 118 federal programs affecting Canadian agriculture and numerous additional Alberta programs (ECA 1985). Since then, the Lands Directorate of Environment Canada has published a compendium of the "Top 100" federal programs significantly affecting Canada's land resource, much of which is land presently in agricultural use (Bond et al. 1986).

Programs are implemented in many ways, such as direct payment to farmers, supply management marketing boards, payments to transportation systems, and special status under taxation legislation. Generally, these programs transfer risk and input costs from the farmer to broader levels of society.

Combined federal and provincial payments to Canadian farmers have reached approximately $3,000,000,000 in 1987, excluding the one-time $1,000,000,000 payment beginning that year. A recent *Financial Post* article suggests the total annual support bill is approaching $7,000,000,000 (Solomon 1988), including both direct government funding and indirect consumer funding.

Some examples of national agricultural programs and national funding levels are cited in *Federal Programs with Potential to Significantly Affect Canada's Land Resource* (Bond et al. 1986). Those that directly affect decisions made by Alberta's farmers include the following:

1) Programs of the Agricultural Stabilization and Agricultural Products Boards, which are designed to protect producer incomes from market price fluctuations, estimated at $407,765,000 for 1984-85.

2) The Western Grain Stabilization Program, which is designed to stabilize incomes of western grain farmers, estimated at $150,000,000 in 1984-85.

3) Hail and Crop Insurance, which provides insurance against loss of crops due to natural hazards beyond the control of producers, with federal contributions estimated at $150,529,000 for 1984-85. In Alberta, the federal government pays 50 percent of the total premium, the Province pays all of the administrative costs, and the farmer is responsible for the remainder.

4) The National Dairy Program, which is administered by the Canadian Dairy Commission, provides market price support for butter and skim milk powder, and direct subsidies for industrial milk and cream, with $268,219,710 estimated for expenditures in 1983-84.

5) Farm Improvement Loan Guarantees, which is a federal program providing loans up to $100,000 at a maximum rate of prime plus 1 percent. The assistance provided by this program is substantial, but not estimated.

6) Subsidies to the railways under the Western Grain Transportation Act (that is, the Crow Benefit), amounting to about $650,000,000 annually.

The Province also has programs that affect Alberta's farmers. For example:

1) In the 1987-88 fiscal year, Alberta Agriculture budgeted for grants of $165,484,762 and $17,791,000 to support primary production and crop insurance respectively.
2) Alberta Environment budgeted $12,951,450 for surface water management and control, and $36,800,000 for capital water works in 1987-88. Most of these expenditures relate to the farming industry.
3) On March 31, 1987, the Alberta Agriculture Development Corporation had active and outstanding assistance to 22,773 clients, for a total of $1,177,600,000.

Participation in some of the above-mentioned programs is voluntary and often contributions from producers are required, as in, for example, the Western Grain Stabilization Plan (WGSP) and Hail and Crop Insurance.

Menzie and Kraft point out that the structure of the farming community is changing. The number of farms is decreasing, but farm size is increasing.

> *In 1981, 78 percent of farm sales were made by 28.5 percent of the producers. The top 5 percent produced 38 percent of gross sales ...*(Menzie and Kraft 1988:4).

They suggest that one third of census farms could be taken out of production with little impact on the industry's output. In 1986, there were 293,089 census farms in Canada; they estimate that current output could be achieved by less than 50,000.

Menzie and Kraft then discuss several potential policy options:

1) the 40 percent of census farms with little production should not be classified as farms for agricultural purposes, and assistance should be restricted to the traditional extension-type information for these operations.
2) the relatively small farmer with the mid-size farm should be helped in one of two ways: increasing organization and management skills leading toward an expanded operation, or assistance to retire from farming or to become a part-time farmer
3) the 20 to 30 percent of farmers who produce the bulk of sales should be assisted with programs oriented toward improving production and management, including marketing.

How should a conservation strategy deal with the changing structure of the agricultural industry, and what role should government policy play?

In addition to the above-mentioned direct programs, a number of other programs affect farming in less obvious ways. These include programs as diverse as the rules under the Income Tax Act (Canada) (including the definition of a farmer), the exploitation and transportation of mineral resources (for example, pipelines), and the right to subdivide the first parcel from a quarter section of land (see Chapter 5, Urban Sector).

Farm income derived from agricultural products is clearly a function not only of commodity prices but of government activity in the marketplace. In recent years, in response to policies of the European Economic Community, government policies and programs have become an increasingly important consideration in a farmer's decision-making process.

What does this mean to the consumer and taxpayer? In 1984, food expenditures represented about 13 percent of disposable income — about $6,066 per year for a family of four (Statistics Canada 1984), or about $3,800,000,000 for the population of Canada. Costs to taxpayers for food production are difficult to determine, but a reasonable estimate in recent years at the federal level is about $3,000,000,000 or $4,000,000,000,

which is about 3.6 percent of projected federal government revenues for 1987-88 (about $96,100,000,000). In total, expenditure on growing food, excluding provincial programs, is about $7,300,000,000 or approximately $11,600 for a family of four per year.

Weather

The geography of Alberta ranges from open, dry, almost desert conditions in the south to boreal subarctic in the north and mountainous in the west. With this type of geography, very wide regional, daily, and seasonal variations in temperature, precipitation, and wind can occur. In summer, the long, sunny days provide sufficient solar energy for rapid plant growth. In winter, the sun is low and provides little warmth.

The Pacific Ocean, which is only 480 km from the western boundary of Alberta, exerts an influence on its weather. Mild winter weather and much of the seasonal moisture comes from the Pacific. The Rocky Mountains usually keep the mild Pacific air out, and cold air over Alberta, except when the Pacific air is drawn across the mountains in the wake of north-tracking lows.

In the southern part of Alberta, chinook winds are common. These winds originate in the Pacific region and bring warm weather to southern Alberta for short periods of time. A chinook wind can raise the temperature 28 to 33 degrees Celsius in a few hours.

The weather at the higher elevations on the Eastern Slopes of the Rocky Mountains affects agriculture. The foothills experience cooler nights in the summer and the frost-free period is shorter than that of the plains region. At the higher elevations, spring and autumn are usually wetter than on the plains, which can interfere with seeding and harvesting. The planting of some varieties of cereals is limited.

Two-thirds of the annual precipitation in Alberta falls in the five growing season months, May through September, which is an advantage to agriculture. Snowfall contributes only one-third of the annual precipitation and is not an important contributing factor to agricultural production. Chinooks evaporate much of the snow in the southern part of the province and in the Peace River area. Heavy run-off from snow melt can create drainage problems in the less windy regions of the province.

Parts of Alberta have some of the highest frequencies of hail in the world. Crop losses can run into millions of dollars.

High summer temperatures and long days provide favorable conditions for crop growth in much of Alberta. Of special significance in crop production are the number of **degree days**[1] and the frost-free period. Degree days in Alberta vary from 1,600 to 1,800 in the southeast to 800 or less in the foothills west of Red Deer (McGill 1982). The average frost-free period ranges from 60 to 88 days.

The major wind hazard (chinooks) occurs in southern Alberta. The chinooks' removal of snow cover is helpful for grazing livestock, but is detrimental on fallowed fields because it dries out the soil and leads to wind erosion.

Soil, climate, and weather maps for Alberta are available and serve as excellent guides in judging the suitability of areas for specific types of agriculture. Proper selection of agricultural practices for each area is an effective conservation measure.

The Decision(s)

To operate successfully, a farmer needs to determine how to maximize revenues and minimize expenditures. However, at least three major considerations that influence the overall decision are essentially beyond the farmer's immediate control.

First, decisions are affected by the equity position of the farmer. Those who do not have a

1 **Degree Day** — A degree day is defined as the number of degrees Celsius above some minimum (usually 5 or 5.6°C) summed over the year or the growing season. For example, two days at 20°C would be 30 degree days above 5°C.

debt load (32.9 percent of Alberta farmers in 1985) are in a better position to make judgments from a long-term perspective. The time horizon of those who are carrying some level of debt tends to become shorter because interest rates fluctuate with the continual changes in world financial markets.

Second, situations and information can change rapidly. During a growing season there can be dramatic changes in weather, commodity markets, government programs, availability of farm chemicals, and grasshopper outbreaks, or even unique events that affect large agricultural areas (for instance, the nuclear accident at Chernobyl). Unexpected decisions always need to be made, usually with incomplete information.

Third, decisions are influenced by previous decisions (such as machinery available), and are followed by more decisions: when should I plant? Should I use a post-emergent herbicide? At what moisture level should I harvest? Will that tractor part last through the next few weeks? Should I use crop rotation as a method of enhancing soil quality? The farmer may find that some options are precluded by previous events.

Farmers' decisions affect both themselves and the resource base upon which they and society depend. Many of the criteria farmers use to make decisions originate in areas beyond their control. The farmer has greater latitude in decisions about preferred income sources — the marketplace, off-farm employment, and government programs — and almost complete freedom to decide how to most efficiently utilize the inputs available.

The commodities a farmer decides to produce are also linked to the available resource base. The important considerations are the capability of the land and the range of crops that can be grown successfully.

Chapter Three

Impacts of Decisions

General Considerations

In terms of their effect on the land base, some general comments can be made about livestock, cereal grain, and mixed farm operations.

Extensive livestock operations tend to have three important characteristics with potential to lead to long-term sustainability of the soil base:

1) Livestock require a varied feed source, usually a combination of barley, alfalfa, hay, and grasses from unimproved or improved pasture. Feed grains can be produced in rotation with other crops, alfalfa contributes to soil organic matter content, and grasses protect soil from erosion.

2) Livestock can be used to obtain a return from lower quality land. Much of the lower quality land that is suitable for extensive livestock operations would be erosion prone if it were cleared and used for the production of annual crops.

3) An important byproduct of raising livestock is the production of manure. This can be used as a slow-release fertilizer. Manure mellows the soil, improves the physical composition of problem soils, and leads to yields exceeding those expected from the amount of nitrogen and phosphorous contained in the applied manure (Sommerfeldt 1987).

The effects of grain operations on soils are more problematic. Typical cropping practices include cultivation, seeding, fertilizing, chemical weed and pest control, and fall harvesting. Usually crops are rotated over a three- to five-year time span, and **summerfallow**[1] may be used to control weeds, retain soil moisture, or release nitrogen. Many modern grain production techniques are most effective when large machinery is used.

Some grain management practices can be detrimental to the soil, others can be beneficial, and of course the effect can vary with specific circumstances and timing. However, major beneficial effects center around two themes:

1) retention of a year-round soil cover that is adequate to prevent wind or water erosion

2) replacement of the nutrients and organic matter lost from the soil when a crop is produced and harvested.

These effects are interrelated. Good water management and good soil management share the same objectives. Loss of soil through water or wind erosion also means a loss of associated organic matter and nutrients. A soil that is deficient in organic matter also has poor **tilth**[2] and becomes increasingly susceptible to erosion.

From the perspective of soil erosion and nutrient/organic matter, a rough generalization of the impact of various management practices as-

1 **Summerfallow** — Land not planted, but plowed and frequently tilled during the summer in preparation for a crop the next year.

2 **Tilth** — The physical condition of a soil in respect to its fitness for the growth of a specified plant or sequence of plants. Ideal soil tilth is not the same for each kind of crop nor is it uniform for the same kind of crop growing on different kinds of soil.

Table 3. Consequences of Management Practices for Grain Production

Practice	Erosion	Nutrient/ Organic Matter
rotation of crops	decreases	increases
summerfallow	increases	decreases
conservation tillage	decreases	increases
retention of stubble	decreases	increases
green fallow	decreases	increases
stubble mulch	decreases	increases
stubble burning	increases	decreases
use of legumes	decreases	increases
use of chemical fertilizers	decreases	increase or decrease
herbicides	increase or decrease	increase or decrease
insecticides	neutral	neutral
use of heavy machinery	increase or decrease	neutral
shelter belts	decrease	neutral
pre-emergence herbicides	increase or neutral	neutral
manure	decrease	increases

sociated with production of grains is shown in Table 3.

It is difficult to get a good estimate of the amount of land affected by erosion. In 1981, Goettel et al. provided an estimate that 495,000 to 990,000 acres annually suffer from erosion in Alberta. There are estimates in the U.S. that up to one-third of the topsoil has been lost through erosion (McGill 1982). Unfortunately, the effects of erosion losses can be masked for some time through the use of various types of soil amendments (McGill 1982).

Recently, Alberta Agriculture has attempted to determine some of the costs of erosion, the effect of crop types, and geographic distribution of the problem (Desjardins et al. 1986). They concluded that presently mean annual erosion is 4.9 tonnes/hectare/year. The value of nutrients lost in this amount of soil, province wide, at 1985 prices, is about $88,700,000. This is a minimum estimate of the consequences of erosion because it does not consider issues such as: loss of organic matter, reduced tilth, costs of distributing fertilizer, and off-site impacts. Even so, this cost represents about 2.3 percent of provincial gross farm cash receipts, 3.3 percent of cash operating expenses, and can affect real net farm income by about 14 percent. Increasing the amount of summerfallow or producing canola rather than a mix of crops increases the value of nutrients lost to an extreme (no ground cover) of $531,600,000 annually. Clearly, erosion control can be a wise financial, as well as conservation, consideration.

Probably the most desirable situation from a soil conservation perspective is to use farming practices that retain soil cover, such as **conservation tillage**,[1] or to have mixed farms. Operations on mixed farms integrate the production of several commodities, such as livestock and cereal crops, and the potential exists for the product or waste of one part of the operation to be used elsewhere in the system. For example, manure can be

1 **Conservation Tillage** — cultural methods to preserve topsoil, such as zero or minimum tillage, in which the next crop is sown directly into the stubble of the previous crop. Weeds are controlled by herbicides.

substituted for or can supplement commercial fertilizers, and alfalfa can be used to increase the amount of nitrogen in the soil and to restore organic matter.

Although mixed farms may be desirable from a conservation point of view, there are forces that work against their establishment. These forces include any or all of the following: the economic advantages of specialization, the need for off-farm employment (which makes livestock husbandry difficult), and government policies and programs that reduce the risks associated with grain and oilseed production. This situation reduces the attractiveness of mixed farming, which has been the private and traditional means of stabilizing income under fluctuating market conditions.

Although domestic government policies and programs have reduced some of the risks associated with market variability, they may have concurrently increased the risk in other areas. The increased production associated with specialization increases dependence on particular commodity markets, the variability of which is strongly influenced by the policies of the European Economic Community and the U.S. (Fulton 1987). Does this increase or decrease the risk to the individual farmer or simply transfer the risk to various provincial and federal institutions? As farm income becomes more dependent upon public policy, does this increase or decrease risk to the farmer? How should a conservation strategy deal with these types of issues? What should be the role of the agriculture community, government, and society, in the maintenance of the agriculture sector and the resources upon which it depends?

Saline Soils

Although soil salinization does occur naturally, dryland farming and leaky irrigation distribution systems have contributed to salinity problems. Excess salts reduce the range, **yield**,[1] and quality of crops that can be grown. For example, beans and corn have a very low tolerance for salt, whereas barley has a high tolerance. Even so, decreases in barley yield of 21 to 62 percent have been reported relative to similar nonsaline soils (McGill 1982).

Salinization of soils primarily occurs in groundwater discharge areas, or the areas where groundwater comes to the soil surface. Salts are dissolved in groundwater, which evaporates at the surface and leaves the salt behind. In irrigated areas, the water often results from leaky irrigation structures or excessive irrigation. Normal precipitation is the water source for the salinization process in dryland agricultural areas.

Dryland farming requires the cultivation of prairie soils. Tilling the soil destroys many early-growing native plant communities. A plant community that begins to transpire water early in the spring is replaced by crops that do not use water extensively until June or July. As a consequence of the excess water percolating through the soil, water tables rise toward the surface, groundwater seeps can develop, and the risk of salt deposition increases.

The situation is even worse under summerfallow conditions. Usually the soil surface is very permeable to rainfall. More water reaches the groundwater table and, when no crops are grown, water is not transpired. Hence, even more groundwater seeps develop and the extent of salinized soil increases.

Figures differ on the extent of dryland salinity in the province. A reasonable current estimate is 1,300,000 acres in the Brown and Dark Brown Soil Zone, and 900,000 acres in the Black and Gray Soil Zones. However, of greater concern is that the estimates invariably include a growth rate in the amount of salinized land of up to 10 percent per year (Lilley 1982). Clearly, not all agricultural land will be affected by salinization, but it is also clear that a key indicator of satisfactory progress is a continuing decline in the area of saline land.

Salinization can be prevented or minimized by reducing the amount of water entering, moving through, or leaving the groundwater system.

1 **Yield** — Biomass produced per unit area, for example, tonnes per hectare.

Such a reduction may necessitate the use of vegetative techniques such as planting crops that use large amounts of water in the recharge or discharge areas. Alfalfa is often used for this purpose, though in many cases continuous cropping is sufficient to arrest and reduce salinity. If vegetative techniques are not successful, there remain the options of land levelling in order to reduce ponding, or surface or subsurface drainage.

Acidification

Acidification is another consequence of cultivation in parts of Alberta. It is thought to threaten 20 percent of Alberta's agricultural soils and 40 percent of those in the Peace River district (McGill 1982). Some soils are naturally acidic, while others become acidic through extensive use of nitrogen-based fertilizers, or, occasionally, as a result of aerial emissions from industrial facilities. Rectifying the situation can be expensive, but it is technically simple — application of lime to the affected soils. Unfortunately, this solution deals with the symptom while the cause usually continues.

Solonetzic Soils

Solonetzic soils have a tough hardpan 5 to 30 centimeters below the surface, which severely restricts root and water penetration into the soil. These soils originate from parent materials rich in sodium. As the soil formed, the soluble salts were leached downward, leaving a sodium-hardened pan.

There are 4,000,000 to 5,000,000 hectares of solonetzic soils in the central and Peace River areas of Alberta, about 30 percent of the arable land. Productivity of solonetzic soil is lower than that of other arable soil because of the thin topsoil and poor moisture regime for crop growth.

Moisture problems include a moisture deficit limitation, as in the Brown Soil Zone, or a moisture storage limitation, as in the Dark Brown, Black, and Gray Soil Zones (Lickacz 1986).

Improvement of solonetzic soils has been most successful in the Dark Brown, Black, and Gray Soil Zones through subscribing or ripping, which breaks up the hard pan without moving soil horizons. It is also possible to modify some of the extreme characteristics of the topsoil by using lime or other additives. Deep plowing can be used to mix soil horizons, but it seems to be less popular than other methods used by farmers.

Although research has shown that increased soil moisture storage is largely responsible for improved growth, there is a need to identify in detail variability of solonetzic soils across the province. There is also a need to develop custom-made improvement methods (alkaline and solonetzic soils frequently appear in the same watershed) and to implement them more widely at the farm level.

Chapter Four

Increasing Farm Income

If a farmer wishes to increase farm-derived income, the increase must come about through diversification of products sold, through increasing the amount of present product sold, or through maximizing the difference between what it costs to produce a commodity and the income derived from the sale of the commodity. As has been indicated in Chapter Two, the price paid for a commodity relates both to demand and to government policies and programs. Where the farmer has most short-term direct control is in choice of product, allocation of inputs, product yield, product quality, and proximity to market.

An individual farmer has two primary means for increasing the production of a crop or livestock:

1) increasing the inputs on the existing land base. Resources previously allocated elsewhere in the farming operation may be diverted, or new resources may be brought in.

2) bringing more land into production. This tends to be land of poorer quality than that presently in agricultural production. Consequently, inputs do not yield as good a return as on better quality land.

Increasing returns through reducing inputs is usually accomplished by using some of the soil's "capital." In this case, soil nutrients may be "mined" and tilth reduced through extensive removal of organic matter, as may be the case with a poorly managed annual silage operation.

Depending on the combination of methods used to increase production or reduce costs, agricultural soils can either improve or deteriorate in quality.

In addition to increasing inputs to the land base and bringing more land into production, there is potential to increase income through innovation and creativity. This can occur through the development of new commodities, through application of new knowledge, and through the use of new technologies. In recent years, biotechnology has received considerable attention because of its potential to increase both yield and quality, as well as to develop new commodities, although new varieties may depend on herbicides and other chemicals to grow. Certainly, the historical trend has been that adoption of new technology on the farm leads to a reduction in costs for each unit of production.

Organic Farming

There is another trend appearing in agriculture, and that is a growing interest in ecological agriculture. This system of farming endeavors to eliminate the dependence on synthetic chemical pest control agents and synthetically derived chemical fertilizers. Pests are controlled through integrated pest management, which may include such techniques as:

a) cultural practices, such as tillage, crop rotation, fallowing, **interplanting**,[1] timing of planting and harvesting, weed cultivation, strip harvesting, and trap crops (to divert pests from favored crops)

1 **Interplanting** — planting two or more crops in alternate rows or strips in the same field.

b) biological controls, such as releasing sterile male insects to a breeding population or using pheromones to lead insects to traps where they are killed

c) natural agents that are pathogenic to the pest, for example, the protozoan *Nosema locustae*, which attacks grasshoppers. These must be used with extreme caution.

As with any agricultural system, when crops are exported from the farm site, the nutrient loss they represent must be replaced. In the case of organic farming, some of the practices that replace chemical fertilizers are the application of farm-produced or purchased manures, "**green manuring**,"[1] and the use of rock phosphate or **greensand**[2] as sources of phosphorus and potassium.

The consequence of this approach to farming has been difficult to document due to a lack of long-term studies. Fortunately, a case study is now available from the Spokane, Washington area. Two virtually identical adjacent farms have been operating under different regimes since 1948, one using organic farming practices and the other using inorganic fertilizers and pesticides. Major differences have been found between the resultant soils, with the organic farm showing "significantly higher organic matter content, thicker topsoil depth, higher polysaccharide content, lower modulus of rupture, and less soil erosion than the conventionally farmed soil." Average winter wheat yields in recent years (1982 to 1986) were 4.50 tonnes per hectare on the organic farm, as compared to 4.90 tonnes per hectare on the conventional farm (Reganold et al. 1987).

At present, organic farming in Alberta is risky. The practices are unfamiliar and require substantial managerial skills to be successful. It is difficult to say what role they will play in the future of agriculture in the province, but it is essential that an organic farming sector be developed. Development of this sector must be sufficient to identify the approaches that work and those that do not work under Alberta conditions. In the absence of such efforts, future markets and technologies may be forfeited to innovators elsewhere.

Horticulture In Alberta

Horticulture is a specialized agricultural operation that includes the cultivation of fruit, vegetables, cut flowers, and ornamental plants, including lawn turf. By its nature, it involves very intensive methods of cultivation, high technology, and a large labor force. It may require considerable climate control and associated energy consumption (greenhouses and atriums). To be economically viable, it must therefore have a high cash return. Horticulture is also a major recreational activity and contributes greatly to the quality of life. Horticultural activities can be organized into:

- Floriculture — the growing of flowers.
- Olericulture — the growing of vegetables.
- Pomology — the culturing of fruit.
- Ornamental horticulture — the cultivation of trees, shrubs, lawns, etc. for ornamental purposes (Grainger 1987).

It has been estimated that some 37 percent of our food intake is horticultural in origin, but in Alberta this has not led to a major industry. Such an industry has not developed because of limited markets due to a small population and the ease of transporting horticultural products from more favorable growing areas like California. However, horticulture does provide some diversification to present agribusiness and may well provide more in the future. Some information from the 1986 agriculture census (Alberta Agriculture 1987b), and Grainger (1987) provides an idea of the industry's scale in the province, as follows:

1 **Green Manuring** — turning under a crop grown for the purpose, to decompose and contribute to soil fertility and tilth.

2 **Greensand** — unconsolidated sedimentary deposit of the green mica mineral glauconite, used in agriculture as a source of potassium and phosphorus to improve soil fertility.

- 151 farms reported 85 acres in tree fruits including apples, pears, plums and prunes, sweet cherries, sour cherries, and apricots
- 403 acres were in berries, primarily strawberries and raspberries
- 8,895 acres were planted in vegetables: asparagus, sweet corn, tomatoes, cucumbers, cabbage, yellow beans, green beans, beets, cauliflower, onions, peppers, rutabagas, cantaloupe melons, radishes, brussels sprouts, rhubarb, parsnips, celery, spinach, lettuce, broccoli, squash, zucchini, pumpkins, and green onions
- 5,143 acres were in nursery products
- 5,830 acres were in sod
- Selected estimated cash receipts were

potatoes	$30,000,000
floriculture and nursery plants	$25,000,000
vegetables	$26,000,000

- in 1984, there were 227 greenhouses, covering 129.6 acres and employing 1,140 people, with a payroll of $9,997,714 and annual sales of $31,242,857
- in 1986, 2,860 people were employed in municipal horticulture
- in 1986, the value of all trees and shrubs on golf courses was $112,600,000.

Many factors contribute to the interest in horticulture. There is an increased awareness of the superiority of locally grown produce, which can be picked at an optimum time and reach the customer quickly in prime condition; there is a steady demand for organically grown produce and there is an interest in varieties that are not economical for the large grower. These factors have resulted in a tremendous expansion of Farmer's Markets and similar expansion of small market gardens. Another side of this demand is an increase in the number of self-pick operations. It is expected that this preference will be of particular benefit to soft fruit growers, whose labor costs are high. Present strawberry production is only 89 acres (Statistics Canada 1987). Manitoba supports 600 to 700 acres and it is estimated that Alberta could support 1,000 acres. Recent research into saskatoon growing, harvesting, and marketing has brought this crop to the front line. In 1986, 28 growers were supplying the Peace River Country Fruit Producers Co-op from 300 acres planted to saskatoons and the number of producing acreage was expected to increase rapidly. A market survey indicated that it would take 10,000 acres to fill current demands (Grant 1986).

Horticulture is also a prime leisure activity, indulged in to a greater or lesser extent by the majority of the population. It has been established that the average family household spends $234 per year on their garden (Grainger 1987). In Alberta in 1983, there were 43 local amateur garden or horticultural clubs affiliated with the Alberta Horticultural Association, plus a number of small societies dedicated to individual species, from orchids to lilies. The Friends of the Devonian Botanic Garden Society has 1,200 members. Garden and flower shows are an important adjunct to agricultural shows. Those who do not garden appreciate the pleasure provided by plants in commercial atriums, offices, and shopping centers; benefit from the climate-moderating influence of street trees; or enjoy visits to conservatories, botanic gardens, and parks.

A number of valuable and labor-intensive support industries are necessary to horticulture. These include machinery sales, greenhouse builders and suppliers, atrium installation, fertilizer and chemical suppliers, ornamental plant importers, florists, sphagnum peat mines, and retail vegetable and fruit sales. Of great importance is the landscape architect, both commercial and residential, and the landscape maintenance firm. Also necessary is a support network of research and training facilities.

Horticulture presents the conservationist with problems similar to those provided by modern agribusiness agriculture. However, because of the intensive methods of cultivation, these problems may be more severe. Rates of fertilizer and pesticide application are often high and there is a high demand for fuel, power and water.

A grower may not be using local soil, but instead brings in good loam and peat from elsewhere in the province. A botanic garden may have to clear land and control animal "pests." Even the home gardener will be using fuel, fertilizer, pesticides, and water to provide that perfect lawn.

Increasing Inputs on the Present Land Base

Inputs are the elements necessary to produce commodities. A partial list of farm inputs includes: land, financing, buildings, machinery, management, pesticides, fertilizer, and labor. Several inputs that have directly contributed to yield increases are: improved biological/genetic characteristics, more and better chemicals and machinery, and better management practices. From 1930 to 1980, these particular improvements have been perhaps largely responsible for an annual increase in yield of about 1.5 percent (Marv Anderson and Associates Ltd. 1983).

Farm operating costs in Alberta have tended to decrease since the 1981 census (Figure 2). In 1981, total operating costs were about $2,500,000,000 as contrasted with approximately $2,100,000,000 in 1985 (1981 dollars). The increase in acreage, from 47,218,170 to 51,040,463 acres in that five-year period, means that the operating costs on a per-acre basis have dropped from about $54 per acre to approximately $41 per acre, or by about 24 percent.

Operating costs are dominated by machinery repairs; interest on debt, fertilizer, and lime; and feed (Figure 3).

In 1986, the total market value of Alberta's farm machinery was over $5,000,000,000. It included 150,479 tractors, 146,309 trucks, 49,144 swathers, 42,970 combines, and 37,578 mowers (Statistics Canada 1987). From 1981 to 1985, the

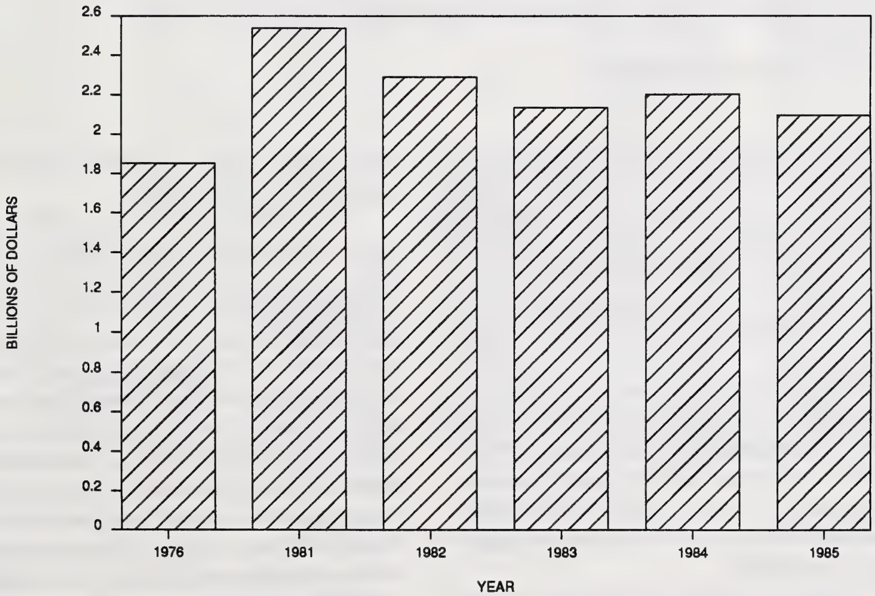

Figure 2. Total Farm Operating Expenses

(in 1981 dollars)

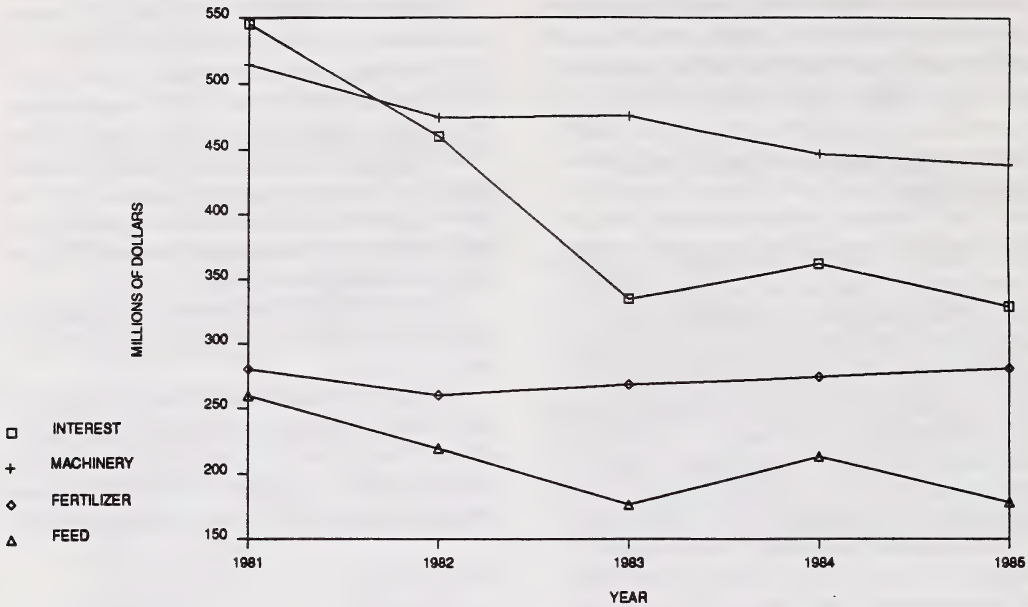

Figure 3. Major Agriculture Operating Costs, 1981—1985

(in 1981 constant dollars)

costs of operating this equipment consistently exceeded 20 percent of total farm operating costs (Alberta Economic Development and Trade 1987). An important component of these costs is energy, largely derived from fossil fuels. It has been estimated that farm production accounts for 2.7 percent of Canada's fossil fuel use (Strayer and Zoerb 1980).

Interest on farm debt was 21.5 percent of total farm operating costs in 1981, but has shown a gradual decline since. By 1985 it was 15.7 percent of total operating costs (Alberta Economic Development and Trade 1987). Unfortunately, 1986 estimates show a rise to 16.8 percent (Alberta Agriculture 1987b).

It is important to note that debts are a commitment with first call on a farmer's financial resources. A farmer may be able to delay implementation of a better technology for a year or more, but the same flexibility seldom exists in obligations to debt holders.

Debt obligations require a cash flow. The larger the obligation, the greater the cash flow required. Meeting this obligation generally entails substituting longer term losses for short-term gains. This strategy may mean increasing short-term revenues by going to cheaper inputs, such as using summerfallow rather than fertilizer to replace nitrogen for next year's crop. Perhaps the same acreage is harvested, but less than optimal inputs are used. If there is a trend toward increasing grain prices, it might look worthwhile to cultivate land better suited to extensive grazing (the effects of erosion will not be felt for several years). Growing canola on the same land for several years in succession (requiring a fine and erodible seed bed, removing considerable amounts of nutrients, and allowing pests to build up) can all lead to long-term costs, but what else can be done when the

banker is waiting? Short-term survival, by the nature of the imperatives, nearly always overcomes the need to maintain a high-quality soil base.

Fertilizer and lime costs averaged about 12.2 percent of total operating costs from 1981 to 1985 (Alberta Economic Development and Trade 1987). In Alberta the amount of fertilizer sold increased from 10,842 tonnes in 1945 to 734,209 tonnes in 1980 (Thompson 1981; Statistics Canada 1982), and in 1984 and 1985 exceeded 1,000,000 tonnes per year (Alberta Agriculture 1986). However, there is a break in this trend; only 923,392 tonnes were used in 1986 (Statistics Canada 1987).

Globally, the ratio of grain production to fertilizer use (tonne of grain per tonne of fertilizer) has declined from 46:1 to 13:1, between 1950 and 1980 (Brown et al. 1987). In the Alberta context, it has been noted that the increasing use of chemical fertilizers in recent years has not been reflected by equivalent increases in crop production. This is because the contribution of nutrients from the soil is decreasing and fertilizers are not providing a total replacement (McGill 1982).

Energy is an important component of fertilizer. The growing global importance of energy use in agriculture, primarily as a fuel and as fertilizer, is well illustrated in Figure 4. By 1985, energy used in world agriculture was approaching the equivalent of 2,000,000,000 barrels of oil per year.

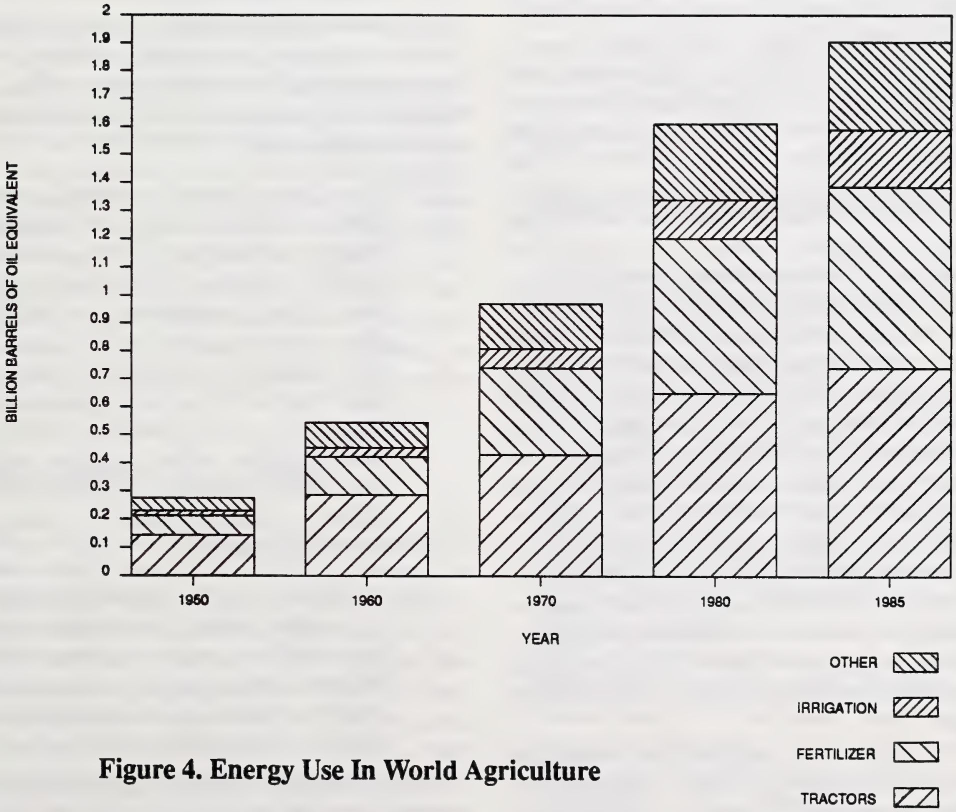

Figure 4. Energy Use In World Agriculture

(fuels, fertilizer, and other)

Energy inputs to farming deserve careful consideration because of their cost and the question of their sustainability. Recent estimates show that the amount of energy required to produce a tonne of grain has more than doubled in the last 35 years — from 0.44 barrels of oil equivalent in 1950 to to 1.14 barrels in 1985 (Brown et al. 1987).

Because energy-related expenditures are such a high portion of total farm operating costs, they attract government programs designed to assist the farming community. These programs can be implemented through various means, for example, by eliminating fuel taxes or farm fertilizer price protection, or by reducing the freight costs for lime. However, artificially reducing energy-related costs encourages excessive consumption of energy-related inputs.

The implications of increased energy-related inputs to soil conservation can be diverse. The following examples illustrate this diversity.

Cheap fuel encourages mechanization and use of large machinery. Powerful machinery is required for conservation tillage agriculture, which reduces soil erosion potential. However, if the large equipment is used in conventional agriculture practices, it may be necessary to enlarge fields by removing shelter belts or by other measures, thereby increasing susceptibility of fields to wind erosion. Large machinery frequently operates at higher speeds, which can increase wind erosion potential. Large new machinery can have greater or lesser loading on the soil relative to its predecessors. Hence, soil compaction can be increased or decreased, either facilitating or inhibiting water penetration and erosion. Reduced fuel costs may mean that it is cheaper to control noxious weeds through the use of summerfallow, rather than herbicides. Which production alternatives are more attractive from a soil conservation point of view, and is the effect the same in all parts of the province? How do farm accounting systems deal with these types of conservation issues?

Nitrogen, usually obtained from natural gas, is the primary component of most commercial fertilizers sold in Alberta. Nitrogen is an important limiting element for plant growth and it is usually taken up by plants in a nitrate form. Nitrates are water soluble and consequently very mobile in a watershed. This mobility can lead to nitrate contamination of groundwater and high nitrate levels in surface waters. Nitrate-contaminated groundwater is a serious problem in many parts of the world and has resulted in many groundwater sources being declared unfit for human consumption (Brown et al. 1987).

Nitrates can act as a fertilizer for aquatic plants and may stimulate their growth. Excessive growth of aquatic plants often leads to two interrelated problems:

1) obstruction of surface waters, which impedes water flow and can be detrimental to many types of use
2) deterioration of water quality when the plants die and decompose.

However, modern farming requires fertilizers in order to replace the nutrients lost with the harvest. To maintain a soil base that will continue to support the agricultural industry, some questions must be addressed:

1) Are all the elements required for plant production being replaced, and in the appropriate proportions? Plant production requires nitrogen, phosphorous, potassium, calcium, magnesium, and sulphur, plus trace amounts of at least 11 micronutrients. Commercial fertilizers place the greatest emphasis upon nitrogen, phosphorous, and potassium. Other elements are often omitted, and they may or may not be required. Optimum plant health is directly related to balanced nutrient availability.
2) Do fertilizers contain chemicals detrimental to plant growth? For example, phosphate rock is a source of phosphate for fertilizers. Processing the rock can concentrate elements, such as heavy metals, which are potentially toxic to plants.

It would seem that, with increasing use of fertilizers, it is also becoming increasingly important to monitor:

- what was in the soil initially
- what is being removed from the soil
- what is being added to the soil.

There are other operating costs, which usually range from 5 to 8 percent of total operating costs. For example, the category of "other crop-related expenses" has shown a gradual upward trend from 5.8 percent of total operating expenses in 1981 to 7.8 percent in 1985 (1981 constant dollars) (Alberta Economic Development and Trade 1987), and a major portion of this is for pesticides (insecticides and herbicides). These pesticides are used to increase income by improving both the quality and quantity of agricultural commodities. Herbicides are used to prevent the growth of weeds, which compete for soil resources and whose presence reduces the quality or grade of the crop being raised. Pesticides are intended to protect the crop from attack by infectious agents or insects.

The weeds and pests that pesticides are designed to control are constantly evolving. Many have high reproduction rates and short life spans, a situation which leads to the development of strains resistant to commonly used formulations. Ultimately, pesticides select for their own failure and require replacement with newer and frequently more expensive products. Hence, a pesticide-dependent agricultural industry requires a constant influx of research and technology in order to maintain current levels of efficiency and effectiveness.

Expanding The Land Base

Alberta's best agricultural lands are presently in production. Although provincial production of agricultural commodities can be increased by bringing additional unused lands into production, these marginal lands would require disproportionately higher levels of inputs. The best returns per unit of input occur on the best lands. Bringing inferior lands into production will probably depress average yields (Marv Anderson and Associates 1983) and reduce profit margins.

It is interesting that increasing the production from high-quality lands often maintains or improves soil quality (McGill 1982). This phenomenon can be seen in many prairie farms where organic matter, nitrogen content, and tilth have remained constant or improved after many years of cultivation.

Properly managed agriculture can be a soil enhancer and improver. If marginal soils (CLI classes 4-6) are brought into production, the commodities produced must be compatible with that land type. In many cases, the best use of poorer agricultural lands is for extensive livestock operations, particularly cow/calf operations, with feeding and finishing taking place on soils capable of annual arable production of feed.

Increasing cattle production by enlarging the land base may be an inappropriate response to market signals. A balance needs to be struck between the demand for cattle, the present expansion of feed grain surpluses, and the biological reality of the time required to increase herd size. The cattle cycle can be a trap for the unwary and the novice farmer.

Mining The Existing Land Base

A very short-sighted approach to increasing profits, but not necessarily production, is to mine the present land base. In some circumstances, inputs can be minimized, thereby creating greater net revenue. Examples of mining techniques are improper management of summerfallow and continual production of silage on the same ground.

Summerfallowing is usually justified on the basis of water retention, weed control, or release of nitrogen. In 1958, farmers would expect about a 75 percent higher yield of wheat, oats, and barley if they planted on summerfallowed lands. By 1979 this expectation had dropped to zero for wheat, and to 10 percent for oats and barley (Marv Anderson and Associates 1981). However, 1985 Alberta Wheat Pool data show Alberta regional yields of wheat seeded on summerfallow were up to 57 percent larger than those seeded on stubble (Alberta Wheat Pool 1986). Clearly, decisions must be made for each farm and each soil type on a case-by-case basis.

Summerfallowing creates a cheap source of nitrogen. Mineral nitrogen accumulates because organic matter in the soil decomposes during the fallow year. Of course, production of nitrogen also means a decrease in the capital stock of organic matter that was found in the soil. Unless this organic matter is replaced, soil quality drops.

In the past, the Canadian Wheat Board quota system appears to have encouraged summerfallowing, because the quota is based upon the total area cultivated, not just the area cropped. Since summerfallowing helps to reduce on-farm inventories, it also serves to encourage a straight grain operation over mixed farming (McGill 1982). Such perverse effects of income stabilization programs are not unusual. Fortunately, the Wheat Board is responding to this situation. Changes to the quota formula are likely (Alberta Wheat Pool 1986), and the new system will probably be based on the amount of grain producers wish to deliver to the Board (Advisory Committee to the Canadian Wheat Board 1988).

An intensive silage operation attempts to retrieve all above-surface organic matter. This means that very little straw remains to decompose or to be tilled into the soil. As a consequence, the organic content of the soil drops and the soil becomes increasingly prone to erosion and a poor medium for supporting future crops. However, since silage is only used as animal feed, it is possible to supplement soil organic matter if the manure is disposed of on the land used for silage.

Chapter Five

Relationships With Other Resource Users

The preceding material is intended to illustrate some of the decision making complexity that an individual farmer can experience, and to demonstrate that those decisions can have an impact upon the province's renewable resources. Moreover, those decisions also have an impact upon other resource users, and, of course, other resource users can have an impact on farmers.

A major thrust of the Alberta Conservation Strategy project is to encourage resource users to recognize the interests of other resource users and to search for mutually beneficial solutions when difficulties or opportunities arise. Of all the sectors identified in the Alberta Conservation Strategy project, agriculture probably has the greatest number of interactions with the other sectors.

The Urban Sector

Historically, Alberta's settlement patterns reflected the primary industries of trapping, forestry, and farming. Not surprisingly, many settlements began on, or adjacent to, good agricultural land. Much of the best agricultural land in the province is in the most densely settled region, the Calgary-Edmonton corridor.

Over the years, the province has increased in population and has become progressively more urbanized. The number of farms has decreased and the average age of farmers has been going up. In 1931, over 50 percent of Albertans lived on farms. This percentage has decreased in every subsequent census, to 10.4 percent in 1976 and 8.5 percent in 1981, when 190,755 Albertans out of a population of 2,237,724 lived on farms.

Increased urbanization can cause concerns in the farming community in at least three ways.

Farmland can be lost by direct conversion to urban uses through industrialization, annexation, or development of rural subdivisions. Unfortunately, the historical pattern is that better agricultural land is converted to urban uses more frequently than is poorer quality land. There are good reasons for this — many of the characteristics of good farmland are the same as those sought by urban developers (level, well drained, etc.), and the largest, most viable, and rapidly growing urban centers had their origins in servicing prosperous agriculture that developed on high-quality soils. Individual farmers can benefit substantially from the sale of farms at urban land values.

Subdivision often leads to fragmentation of farmland. Fragmentation may affect the configuration of fields, making operation of farm machinery more difficult. Proximity to subdivisions and urban areas can also drive up the price of farmland and thereby make conventional farming operations less attractive. Increasing numbers of urban-oriented neighbors can increase the potential for conflict, ranging from harassment of animals to complaints about farm smells and noises. It has been estimated that for every acre of farmland used for urban purposes, another two acres are lost to agricultural use (Krueger 1977).

Introduction of a largely urban population into rural areas can lead to conflicts in lifestyle and can change local government patterns. Residents of rural subdivisions may request a higher level of service (for example, snow removal and sewer systems) than the more self-reliant farming population; they may prefer to utilize more dis-

tant urban services for fuel, retail, or personal services, thus leading to alienation of local business people; or they may become numerous enough to alter the balance on local municipal councils.

There is also the possibility that lifestyle conflicts can lead to situations where actual damage can occur. For example, a farmer may be spraying herbicides and the spray could drift onto the gardens of rural subdivision residents and other farmers. Perhaps the rural subdivision residents have dogs that harass livestock, thereby leading to reduced weight gain and loss of revenue for the farmer. A livestock operation may produce smells that are offensive to new neighbors. In addition, there are the normal situations that arise with increasing populations on a shrinking land base — trespass, vandalism, and rising land prices.

Increased urbanization of agricultural land can represent both problems and opportunities to the sustainability of farming in Alberta. How these groups can best work together is a challenge for all of us. The development of an Alberta Conservation Strategy may provide us with the opportunity to face this challenge, in an open and frank discussion.

For example, a major initiative is the recent passage of Alberta's Right to Farm Legislation, the Agriculture Operation Practices Act. Is such legislation compatible with the Charter of Rights and Freedoms, and what is its relationship with the Common Law Tort of Nuisance? Is it reasonable to have a right to continue all forms of agricultural operations at the same time as there is a provincial policy to allow first-parcel subdivisions out of a quarter section? The latter policy increases the potential for urbanization of rural areas, thereby increasing the probability of conflict between urban and agricultural land uses. Also during the next era of urban expansion, which is inevitable, do we wish to see any special efforts to retain prime agricultural land in farms or should ease and cost of servicing be the major criteria for urban expansion?

The Wetlands Sector

Wetlands, including sloughs and marshes, provide opportunities and present problems to the farming community. The tendency throughout the province is to reduce the number and size of wetlands through drainage programs, often supported by substantial public funding. There are many reasons for farmers to drain wetlands:

1) Wetlands are not normally available for farming, so if they can be drained, the usable amount of land on a farm increases.

2) Wetlands can be an impediment to the use of large machinery, both because they change size during the year and because they may be difficult to maneuver around.

3) Wetlands may be used by resident waterfowl or by migrating flocks. A wetland area adjacent to a good barley crop is a recipe for a reduced harvest. Similarly, hunters are attracted to the area, which may or may not be compatible with the farmer's interests.

4) Wetlands are often groundwater recharge areas. If a farmer has a problem with salinization, it may be possible to resolve it by improving drainage or removing the recharge area (the wetland).

5) Ephemeral wetlands can be drained into a single depression in order to create a permanent water body. This can then be used for watering livestock, or perhaps stocked as a recreational fish pond.

6) Wetlands can be a source of noxious weeds.

The general pattern throughout the agricultural community is to reduce the number and extent of wetlands. This trend results in an increase in the agricultural land base, a lowering of the groundwater table, accelerated runoff, and a decrease in wildlife populations that are dependent upon wetlands.

There are both advantages and disadvantages to the farmer in the above patterns. For example, increasing the usable land base within existing farm boundaries is advantageous if the marginal cost of drainage is less than the marginal gain in production from the drained area. This may be difficult to determine. What is the

value of a muskeg as a shelter for livestock or as a wind barrier that reduces the amount of soil erosion? Does a dropping groundwater table affect local wells, or perhaps reduce the productivity of crops, like alfalfa, that have deep roots and a high water demand? Is the loss of marsh hay in ephemeral wetlands fully compensated for by increased grain production?

Accelerated runoff may mean that it is possible to get on the land faster in the spring. However, what are the implications to soil moisture conditions during the growing season? Will there be an increased demand to supplement soil moisture levels through publicly funded irrigation projects? More rapid runoff may mean that existing stream channel capacities and water storage areas are inadequate. Hence, there will be increased downstream flooding and erosion, frequently of other agricultural lands. These problems can lead to a demand for channelization of streams, flood control structures, water storage facilities, new bridges, and compensation for flood damage. Programs to meet such demands are usually cost-shared between the local and provincial levels of government, with the trend toward increasing provincial shares of the costs.

How should the tension between agricultural and wetland interests be addressed in the Alberta Conservation Strategy? Should public resources be used to encourage or discourage wetland drainage? What about water management programs that rationalize water distribution on a farm but discourage discharge from the farm? Is wetland drainage another example of short-term gain for long-term pain? What do we need to know to identify which types and what quantities of wetlands are essential to the long-term sustainability of prairie agriculture?

The Coal Sector

Over 80 percent of Alberta's electricity comes from turbines which are fueled by thermal coal. Much of that coal underlies the agricultural regions of the province. In order to extract the coal, the overburden (often agricultural land) is removed with large draglines. The coal is then extracted, often with front-end loaders, and transported to the generating station, which is usually nearby. The generating station may be located on land suitable for agriculture, and often its stack is a significant source of oxides of nitrogen and sulphur. After the electricity is produced, it is transported to market through large (and later smaller) transmission lines. That market includes the farms of Alberta. The coal and agricultural industries share interests in many stages of electricity production.

About 90 percent of recoverable coal is found in the plains region, and it has been estimated that agriculture is the prime use for at least 47 percent of the total coal field acreage in Alberta (Webb 1982). Relative to the total amount of agricultural land in Alberta, the amount presently disturbed by coal mining is small. In 1981, about 99 percent of thermal coal production came from five surface mines and the amount of land disturbed at these sites was about 7,800 acres. From 1976 to 1981, about 2,200 acres had been reclaimed. Although land may be out of production for several years, reclamation is required by Alberta statutes. This land invariably changes ownership over the time period, as the mining company will purchase the land required, and normally will return it to local government or to the agricultural sector upon completion of the project.

Reclaimed land may or may not be better for agricultural purposes than it was originally. It can be contoured as desired, amendments can be added, and services provided. There may be a problem with a falling groundwater table, because the coal seam, which is usually an aquifer, has been removed. At times it is reasonable to reclaim coal workings for uses other than agriculture, such as wildlife habitat or parks.

The plant site is like any other industrial facility, and the land upon which it is situated must be considered lost to other uses for an extended time period. However, the plant site has the potential to create off-site effects, primarily through aerial emissions of sulphur dioxide. Although at present there are only a few thermal coal facilities in the province, by the year 2000 coal facilities and oil sands plants are expected to be the largest contributors to aerial emissions of sulphur dioxide in the province. If Alberta has a

moderate growth rate over the coming years, and present sulphur removal technology is used, emissions from thermal coal plants are expected to increase from 180 tonnes per day in 1980 to 618 tonnes per day in the year 2000. However, the thermal coal industry also has considerable potential to reduce emissions of sulphur dioxide. Application of best available technology in 2000 would result in emissions of only 62 tonnes of sulphur per day, or about one-third of that seen in 1980 (Colley and Poon 1982). Hence, soil acidification related to increased coal-based electrical generation is almost totally dependent upon the technology used to control sulphur emissions.

In 1981, there were 98,827 miles of power lines in Alberta. About half of these were rural electrification area lines and utility-owned farm lines. Some lines are built across farmland, although most follow existing road allowances (Webb 1982).

The major effects of transmission lines on the farming community are the removal of land from production, management and control of weeds in those lands, and the additional costs associated with cropping around transmission towers. A worst-case scenario suggests up to about 4,400 acres could be removed from cropping by transmission lines. In 1977, it was estimated that the increased costs of cultivating around a transmission tower were about $35 per structure. Although the Surface Rights Act provides for compensation, many farmers are unaware of this provision and, in turn, management of corridor land can become "no one's business," resulting in problems such as proliferation of weeds.

The potential effect of transmission lines is more significant in irrigated parts of the province. This is because of the difficulties of moving irrigation equipment, particularly side roll and center pivot systems. There is also the need to avoid the dangers of electric shock, either through direct contact with the transmission lines or through spraying.

One of the major questions to be resolved between the agricultural and the coal mining sectors is whether agriculture should always be the priority reuse for reclaimed coal lands. The present policy is to reclaim worked-over lands to a standard of "equal to or better" than the original use. This requirement makes eminent good sense if the original soils were high-quality, highly productive agricultural lands. However, frequently the original use was low-quality, low-productivity agricultural land and only through massive investments in reclamation can low-quality, low-productivity agricultural land be developed into better agricultural land following mining. In many cases, it would be possible to develop first-class wildlife habitat or recreational facilities (for example, ponds for swimming or fishing) for substantially less cost. How should ultimate land use decisions be made? Who should be involved in such decisions and at what level should the decision be made?

The Fish And Wildlife Sector

Agriculture and fish and wildlife interests often compete for the same land and water resources. The thrust of most agricultural operations is to simplify ecosystems so that the production of marketable commodities can be maximized. Much of that simplification is achieved through extensive land clearing and manipulation of the environment with machinery and chemicals. Such activities reduce or eliminate habitat and, consequently, populations of the animals that depend upon it. In contrast, the objective of most fish and wildlife management programs is to maintain or create diverse habitat.

Ownership of land and water resources is a significant consideration when discussing interactions between agriculture and wildlife interests. Most farmland is privately owned, although significant amounts are under some form of public land disposition. On private land, a farmer can do essentially what he wants to, subject to some consideration of broader societal interests as reflected in legislation like the Soil Conservation Act or the Noxious Weeds Act. This freedom means that sloughs can be drained or shelter belts eliminated in order to bring more land into production, if in the individual farmer's view it is appropriate to do so.

When public land is under agricultural disposition, the permit specifies acceptable land management practices. Provision is often made for other uses, such as hunting, after the grazing season is over. However, as is the case with private land, the more intensive the utilization of land for agricultural purposes, the fewer opportunities there are for wildlife. For example, a cultivation lease on public land is a more exclusive use than is extensive grazing, with greater agricultural production being accompanied by reduced wildlife production.

Competition for resources can even occur in areas remote from crop or livestock production. One example in Alberta occurs in the irrigated areas, where water is captured in on-stream reservoirs and used on lands some distance away. In this situation, there is an opportunity to create different fish and wildlife habitat, such as a reservoir-based commercial or sport fishery, or a waterfowl production area. However, irrigation usually represents both a qualitative and quantitative loss of fish and wildlife resources. This loss is due to the flooding of riparian habitats in the water storage areas and the decreased downstream flows, and to an operating pattern for the new systems that reflects agricultural rather than fish and wildlife needs. Indeed, an inefficient, leaky irrigation system is most beneficial to wildlife production.

The problem of competition between agriculture and wildlife also enters crop production considerations. Herbicides are used to reduce or eliminate weeds that compete for soil resources required by a crop. Pesticides perform a similar role against diseases and insects that decrease crop yield or quality, or interfere with the raising of livestock (for example, biting flies). Fish and wildlife managers have concerns about residual chemicals, contaminants, dispersion through binding to soil particles subject to erosion, and drift onto adjacent areas from the use of pesticides (Sanderson 1981).

Similarly, fertilizers can be carried into adjacent watercourses on wind-blown soil particles or, if soluble, through runoff. This can lead to eutrophication of lakes and rivers and subsequent blooms of aquatic vegetation. Winter decomposition of these plants removes oxygen from the water and can kill fish.

Cattle operations are frequently located on streams, particularly along the Eastern Slopes. Many stream fishes live beneath undercut stream banks, and feed off aquatic invertebrates that live in clean stream gravels. These gravels are also spawning areas. Access to streams by cattle can lead to collapsed stream banks and increased erosion and subsequent siltation, which will decrease fish populations. This situation can be avoided through fencing streams and creating alternative watering areas, as has been done on the North Raven River, Prairie Creek, Crooked Creek, and Kerbes Pond, with angler-financed "Buck for Wildlife" projects.

Wildlife can also be a problem to farmers in two ways — predation and consumption of crops. Predation on cattle is a common problem, particularly along the edges of the Green Zone. Even beehives can become a target, as is the case with black bears in the Peace River region. Grains attract ungulates like deer and elk, and migrating waterfowl. The economic impact on farmers has led to the establishment of publicly funded wildlife damage compensation programs.

There are numerous interactions between farmers and the fish and wildlife resources of Alberta. The situations are generally competitive, although there are opportunities for co-operation. Two good examples of co-operative approaches are many of the "Buck for Wildlife" projects, and provision of water for wildlife habitat by the Eastern Irrigation District.

Alberta has the opportunity to benefit from problems and solutions that have arisen elsewhere. In the European Economic Community, the high level of product price supports has led to an increasing conversion of uncultivated land (hedgerows, ditches, bluffs of trees, wetlands) to intensely cultivated lands. The increasing homogeneity and monotony of the agricultural lands and the declining habitat for birds and other animals has led to a negative reaction from urban populations. Since the urban population of the European Economic Community pays a substantial part of each farmer's income either directly in subsidies or indirectly in higher-than-world

prices, if the urban dweller ever decides that farming is no longer worth supporting, farmers and farming would suffer a devastating blow. To avoid such negative reactions, European farmers' organizations have recognized that one of their obligations is stewardship of the land — that the aesthetic and wildlife impacts of farming decisions must be taken fully into account before hedgerows are removed or wetlands drained. In Great Britain, these types of concerns resulted in the 1968 creation of the Countryside Commission, which is responsible for conserving natural beauty in England and Wales and encouraging the provision and improvement of facilities for enjoyment of the countryside and access for open-air recreation (Countryside Commission 1984; Philips and Roberts 1973).

At the present time in Alberta, agriculture is nowhere near as intensive as it is in Europe. A large area of uncultivated land remains in Alberta, although wetlands are under substantial and increasing pressure. Nor is the extent of government support for farming anywhere near the levels of the European Economic Community. On the prairies, the level of farm subsidy averages only $21,500 per farm (Dorin 1987). Urban dwellers still feel that the cost of supporting each farmer is worth it, given the level of stewardship practiced.

However, the experience of the European Economic Community is an early, distant warning. There is some point at which the level of farm subsidy will be weighed against the perceived (urban-oriented) quality of the landscape. This day of reckoning may be many years in the future, and can be avoided through various means, such as the co-operative "Buck for Wildlife" programs operating in some of the Irrigation Districts and the Counties of Red Deer and Minburn, or decreased agricultural subsidies.

The Forestry Sector

The agriculture and forest industry have both competitive and complementary relationships.

With respect to competitive land use, it has been said that "agriculture is to forestry what urbanization is to agriculture." If a farmer in western or northern Alberta wishes to expand his land base, it is normally onto forested land. Just as the agriculture industry loses land to cities, the forest industry loses land to the farmer.

There is also an interesting complementary relationship between the two industries, especially in northern Alberta. Many northern farmers earn a significant amount of off-farm income by working in the forest industry during the winter months. This employment provides a source of revenue for those who are striving to establish themselves in the farming community. It also has another effect — keeping livestock is difficult because farm labor is less available during the winter months, the peak time for forest harvesting. Consequently, although northern Alberta may be capable of supporting a larger livestock population than it does now, the need for off-farm income is one of the forces that directs economic activity in other directions.

One of the essential pieces of information required for good decisions between these sectors is the economic trade-offs between northern agriculture and forestry. Which of these uses has the greatest return for the region and the province as a whole? In the absence of sound, unbiased technical information, the most strident advocate is likely to prevail.

The Oil And Gas Sector

Although farmers receive revenue for infrastructure, such as wellheads and pumping stations, on land they own or lease from the Crown, the direct impact of the oil and gas industry is generally negative. Indirectly, however, many benefits are derived, through the industries' contribution to provincial revenues and hence the ability to fund many agricultural support programs.

As with other mineral resources, the development of oil and gas resources begins with exploration and terminates with marketing, often at a distant location. Seismic exploration is an inconvenience to the farming community and can be a serious problem. Seismic activity used to take place mostly on road allowances and along fence lines, but recent municipal bylaws are starting to prohibit parking of seismic equipment on road-

ways; therefore, there is a shift to seismic activity on private land. The most significant problem, which arises occasionally, is the creation of a flowing hole. This happens when a seismic charge creates the means for water to escape directly from an aquifer to the surface, or to other aquifers. Rerouting groundwater in this fashion may affect local wells and necessitate the drilling of new wells for farmers in the area.

Development of oil and gas reserves involves drilling operations and collection of the resources at common points for transportation to a processing or distribution center. The concerns that normally arise at the drilling stage are wellsite location and access, handling of formation fluids, and drilling muds.

In recent years, Energy Resources Conservation Board guidelines have encouraged the development of wellsites in the northeast corner of oil and gas target areas. This policy has reduced the historical problem of locating wellsites in the center of a quarter section. These wellsites, and attendant roads, often split fields in half and created considerable operational difficulties for the farmer. The difficulties are greatest for cropping operations with large machinery, and these difficulties can be magnified if large, mechanical irrigation sprinkler systems are in use.

However, in heavy crude areas, the abovementioned guidelines for wellsite development are not applicable. Drilling intensity, of up to 64 wells per section, greatly increases the difficulty of carrying out farming. This density of wells on cultivated land seriously increases the work load and decreases the margin of profit to a point where it may not even be practical to try to produce crops. Conservation of topsoil can be very difficult because of the number of wellheads required for extraction of heavy crude, particularly if wellsites are poorly constructed. Livestock operations can also be affected in these areas, again because of the density of infrastructure required and the increased opportunity for cattle to be exposed to contaminants associated with heavy oil extraction.

The effects of conventional oil- and gas-extraction activities are probably least apparent on extensive livestock operations. In these circumstances, the infrastructure of the oil and gas industry occupies far less land than in the heavy oil fields. Grazing on improved or unimproved pasture occurs in the snow-free months. In 1981, it was estimated that about 108,000 acres of agricultural land were occupied by active wells, that about 96,000 acres were abandoned and awaiting reclamation, and that about 70,000 acres had been abandoned and reclaimed (Harrington 1981).

Formation fluids are often saline, and drilling muds, particularly those used for deep drilling, can be toxic. If formation fluids are spilled on the site, the resultant salinity can inhibit plant growth for some time. Drilling muds are often disposed of by "squeezing," a process by which they are worked into the soil near the wellsite. As in the case of spilled formation fluids, this can lead to problems with growth of crops or grass.

Pipelines are generally used to transport the extracted hydrocarbons (tankers are used to some extent in the heavy oil industry). Pipeline construction disturbs soil and requires subsequent reclamation. There have been examples of both increased and decreased crop production on pipeline rights-of-way. Results seem to be largely dependent upon local soil conditions and, more importantly, the quality of the construction and reclamation work. In 1986, around 180,000 kilometers of pipeline were in use in Alberta (ERCB 1987).

Another concern with pipelines is accidental spills. These can occur for many reasons — deterioration of materials, accidental damage, or even vandalism. Reclamation of oil or oil and brine spills can be difficult, as the spill is often in the subsoil. In addition, oil is biodegradable and brine is not. There are provisions in the Surface Rights Act regarding claims for damages relating to spills of this type (Webb 1982).

The oil and gas industry also has extensive interests in sour gas. Alberta is the world's largest exporter of sulphur. Sulphur is extracted from natural gas, which has a high percentage of toxic hydrogen sulphide. Much of that gas is found in agricultural areas adjacent to the Eastern Slopes of the Rocky Mountains. Hence, in these areas, there are additional concerns about the health of

farm animals and personal safety relating to emissions from sour gas processing plants and accidents.

The most important impact of oil and gas development during the boom years (ending in 1982) was the tendency to make Alberta into a high-cost agricultural producer compared to the other prairie provinces, which have less oil and gas development. This effect was due to the competition from the oil and gas industry for services and labor. Mechanics (particularly the most skilled and competent) and repair facilities in agricultural service centers were quickly bid away by the oil patch. Farm labor, having an ability to turn its hand to anything, along with good work habits, was an attractive source of labor to the oil patch. This competition for manpower raised the cost and increased the difficulty of farming in Alberta. The problem was solved temporarily by the collapse in oil and gas development after 1982, but it could recur as the oil and gas industry recovers.

Chapter Six

Conclusion

The agricultural industry affects us all. It is a primary food source; it uses, competes for, and alters public and private resources in order to create its products; it operates in a global marketplace substantially affected by political policy and developing technologies; and it provides foreign exchange.

Agriculture is also an industry undergoing rapid change as economies of scale lead to fewer farmers producing a larger portion of total production. Those economies translate into individual food cost expenditures of about 13 percent of disposable income.

What will the future bring and what role and responsibilities do you see for the agriculture sector in Alberta's Conservation Strategy?

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Appendix A

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